Claims

1. A *S. clavuligerus* microorganism comprising DNA corresponding to one or more open reading frames essential for 5S clavam biosynthesis, wherein said open reading frames are disrupted or deleted such that the production of 5S clavams by said S. *clavuligerus* is reduced and clavulanic acid production is at least maintained, wherein the open reading frames are selected from:

a) *cvm6para* (SEQ ID NO:1);

b) *cvm7para* (SEQ ID NO:2);

c) *cvm6para* and *cvm6* (SEQ ID NO:5); or

d) *cvm7para* and *cvm7* (SEQ ID NO:6).

2 A *S. clavuligerus* microorganism comprising DNA corresponding to one or more open reading frames essential for 5S clavam biosynthesis, wherein said open reading frames are disrupted or deleted such that the production of 5S clavams by said S. *clavuligerus* is reduced and clavulanic acid production is at least maintained, wherein the open reading frames are selected from:

a) *cvm6para* and one or more of *cvm1* (SEQ ID NO:7), *cvm2* (SEQ ID NO:8), *cvm3* (SEQ ID NO:9), *cvm4* (SEQ ID NO:10), *cvm5* (SEQ ID NO:11), *cvm6*, *cvm7* or *cvm7para*; or

b) *cvm7para* and one or more of *cvm1*, *cvm2*, *cvm3*, *cvm4*, *cvm5*, *cvm6*, *cvm7* or *cvm6para*.

3. An isolated polynucleotide comprising open reading frames selected from the group consisting of:

a) *cvm6para*;

b) *cvm7para*;

c) *cvm6para* and *cvm6*;

d) *cvm7para* and *cvm7;*

e) *cvm6para* and one or more of *cvm1*, *cvm2*, *cvm3*, *cvm4*, *cvm5*, *cvm6*, *cvm7* or *cvm7para*; or

f) *cvm7para* and one or more of *cvm1*, *cvm2*, *cvm3*, *cvm4*, *cvm5*, *cvm6*, *cvm7* or *cvm6para*.

4. An isolated polynucleotide comprising one or more open reading frames encoding one or more enzymes involved in clavulanic acid biosynthesis wherein said open reading frames are selected from the group consisting of:

a) *orf2para* (SEQ ID NO:12),

b) *orf3para* (SEQ ID NO:13),

c) *orf4para* (SEQ ID NO:14), and

d) *orf6para* (SEQ ID NO:15).

5. An isolated polynucleotide comprising one or more open reading frames encoding one or more enzymes involved in clavulanic acid biosynthesis wherein said open reading frames comprise one or more of:

a) *orf2para*,

b) *orf3para*,

c) *orf4para*,

d) *orf6para*

in combination with one or more genes involved in clavulanic acid biosynthesis selected from *orf2*, *orf3*, *orf4*, *orf5*, *orf6*, *orf7*, *orf8*, *orf9*, *orf10*, *orf11*, *orf12*, *orf13*, *orf14*, *orf15*, *orf16*, *orf17*, or *orf18*.

6. An isolated polynucleotide selected from the group consisting of

a) a polynucleotide comprising the nucleotide sequence of SEQ ID NO:16;

b) a polynucleotide having the nucleotide sequence of SEQ ID NO:16;

c) a polynucleotide comprising the nucleotide sequence of SEQ ID NO:17; and

d) a polynucleotide having the nucleotide sequence of SEQ ID NO:17.

7. A vector comprising the polynucleotide of any one of claims 3 to 6.

8. A *S. clavuligerus* microorganism comprising the vector of claim 7.

9. A process for improving clavulanic acid production in a suitable microorganism comprising isolating the polynucleotide of any one of claims 3 to 6, manipulating said polynucleotide, introducing the manipulated polynucleotide into a said suitable microorgansim and fermenting said suitable microorganism under conditions whereby clavulanic acid is produced.

10. A process according to claim 9 wherein the polynucleotide is a *cvm* or *cvmpara* polynucleotide and the manipulation comprises disrupting or deleting *cvm* or *cvmpara* gene sequences.

11. A process according to claim 9 wherein the polynucleotide is an *orf* or *orfpara* polynucleotides and manipulation thereof comprises insertion of the polynucleotide into vectors suitable for expression.

12. A process according to any one of claims 9 to 11 wherein the suitable microorganism is *S. clavuligerus*